

WILDCAT REVISION 4.1
PROGRAM BASED ON PMOSS69'S COMMUNITY DEVELOPMENT DSO203 GCC v1.7 APP

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SIGNIFICANT REVISIONS OVER ORIGINAL VERSIONS

-SUPPORT FOR 8MB DEVICES

-RELIABLE TRIGGERING: Efforts have been made to improve triggering performance, something that was notably poor with early programs shipped with the units. Note however that some time base modes have inherent overhead that can cause skipped triggers with random signals. For example, the AUTO mode times out waiting for triggers after a set time so it can auto-scan. While auto-scanning, the frame must finish before any trigger is detected. Most reliable triggering on random or intermittent signals is achieved with the "NORMAL" modes.

-A&B TRIGGER MODE: Trigger on 2 unrelated waveforms simultaneously.

-ACCURATE METERS: The inherent accuracy of an 8 bit sampled signal is rather poor, specially when only a few "steps" are involved with low signal levels. Likewise, the accuracy of time/frequency measurements can be poor when only a few samples are included in the measurement. This revision attempts to improve on this, as much as is possible with accurate calibration, summing ALL frame transfers (rather than just one frame prior to displaying the result), and where possible using quantization error correction.

-LARGE METERS: In addition to the regular types. Fully customizable using same method as the regular meters.

-MULTIPLE CONFIGURATIONS: Up to 10 different saved configurations available for recall. Can also be used to save custom meter settings.

-MENU SHORTCUTS: One button push shortcuts to access V/div, T/div, Trig source and Trig level

-ON SCREEN CHART For quick reference of button functions.

-IMPROVED CALIBRATION: Added functions can help to improve calibration. Master clock compensation (typical units are 60-80 PPM off), the use of 3 digits of precision for voltage calibration, an indicator to precisely set the calibration on the center of a step and compensation for battery/power supply variations. While any of these can be skipped as some tend to be tedious to use, they are available for those who want improved results, and it only needs to be done once.

-IMPROVED X/Y MODE: Ability to adjust buffer size, as well as a persistence mode help "fine tuning" XY mode to properly display moving or complex patterns.

-IMPROVED WAVEFORM GENERATOR: Higher quality waveforms by using up to 10 times greater sampling rates. Also ability to continuously adjust frequency within each range.

-ADVANCED GENERATOR FUNCTIONS: Sweep, burst, white noise, arbitrary and pulse waveforms. Detector mode to display frequency response.

-BMP LOAD: View saved screenshots.

-MAP MODE: essentially displays 200 frames, one per line while modulating color in response to signal amplitude. Useful for example to find missing pulses over an extended amount of time.

-PERSISTENCE MODE: allows a more comprehensive view of a changing signal. Can be set to continually persist, with manual reset, or to auto reset after an adjustable number of frames.

-FFT/SPECTROGRAPH FUNCTIONS: Increased gain by up to 48 decibels (in log mode) and increased dynamic range by using 32 bit buffers. Auto, log and manual amplitude scaling. Summing function provides flat frequency response. Envelope display available with spectrograph.

-IMPROVED WAVEFORM DISPLAY:

-DISTORTION Visible under certain conditions on CHANNEL B caused by error in FPGA programming fixed.

-SWITCHABLE WAVEFORM AMPLITUDE COMPENSATION allows compensation "steps" to be switched off to improve waveform fidelity.

-EXCESSIVE JITTER on the fastest interpolated time bases has been eliminated.

-NON LINEARITY at bottom of screen minimized by shifting ADC operation point.

-MISC ADDED FUNCTIONS:

-CURSOR SELECT METERS allows measurements to be restricted to an area of the waveform defined with cursors.

-MIN/MAX HOLD functions store peak measured values of a waveform.

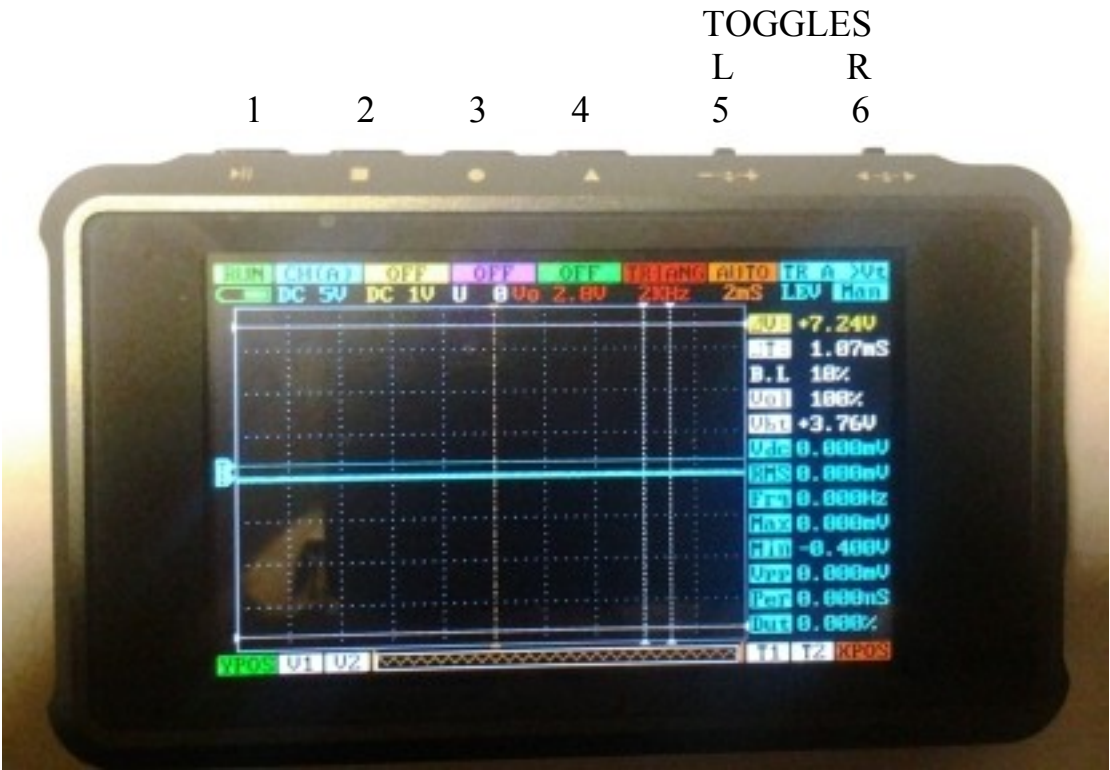
-ALARMS can be set to go off if a value exceeds or goes below a cursor position.

-STANDBY control: Engage standby mode manually or shut off standby timer.

-TRIGGER HOLDOFF for the slower time bases.

-SERIAL, I2C and SPI DECODING

BUTTON FUNCTIONS



ONLINE CHART (Hold button 1 to show on device)

BUTTONS					TOGGLES	
	1	2	3	4	LEFT	RIGHT
PRESS	>	[]	O	^	<o> <ADJ>	<o> <MENU>
SHORT>	HOLD reset	AUTO TRIG	METERS sav/ld (config)	SELECT ITEM	SET TRG CHANNEL (XYperst)/ (Raw-Nor) / (Spc Func)	BUFFER (spec/env) (Change) (Spc) (Func)
LONG>	V/DIV short cut	MAN TRIG	STAND BY	T-BASE short cut	MTR PGE (w/mtrs on) WAV CAL	MENU/MTR STDBY TIM (w/mtrs off)
HOLD>	METERS					
	CHART	CAL (offset)	SAVE (config)	CURSOR RSTRCT	TRIGGER HOLDOFF	HOLD MIN/MAX

BUTTON PRESSES: SHORT PRESS = Press button and do not hold for more than 1/2 second
LONG PRESS = Press button and HOLD for more than 1/2 second but NO MORE than 1.5 seconds
HOLD = Press and HOLD button until function appears, after about 1.5 seconds (~3 seconds for calibration menu)

- 1) BUTTON 1
- SHORT PRESS: TOGGLES HOLD/RUN
RESETS MIN/MAX meters in HOLD MODE
- LONG PRESS: SHORT CUT TO ANALOG CHANNELS V/DIV MENU ITEM
If ALREADY on an analog V/DIV item, will TOGGLE THIS CHANNEL ON/OFF
If NO ANALOG channels are on, will TURN ON channel (in FFT mode will only GO to V/DIV. Toggle trace on/off with second press)
If CH-A or CH-B menu is active, will go to V/DIV item of that channel if not already on it
Otherwise will attempt to go to last channel turned on.
If wrong channel is selected when both are on, shift over with right toggle
- HOLD BUTTON: DISPLAYS BUTTON FUNCTION REFERENCE CHART
Press BUTTON 1 to exit without doing anything
Press ANY OTHER BUTTON to exit chart and execute it's normal function

- 2) **BUTTON 2**
- SHORT PRESS:** Selects AUTO TRIG LEVEL
Will default to 1/2 of waveform level from peak to peak
Press again to select 3/4 and 1/4 of waveform level
- LONG PRESS:** Selects MANUAL TRIG LEVEL MODE
Menu will shift over to TRIGGERING MENU and TRIGGERING LEVEL SUB MENU
- HOLD BUTTON:** Selects CALIBRATION FUNCTIONS if menu selected is of CHA or CHB otherwise selects ADC offset adjustment.
- 3) **BUTTON 3**
- SHORT PRESS:** METERS OFF > REGULAR METERS > LARGE METERS
- LONG PRESS:** ENGAGES STANDBY MODE (In advanced gen mode disables scope providing better waveform quality)
- HOLD BUTTON:** Selects SAVE CONFIGURATION MENU
SHORT PRESS BUTTON 3 AGAIN TO SAVE (Menu will return to prior selection)
Default displayed after boot will be CONFIG #0 (boot up config)
Change config number (0 to 9) if desired before pressing to save (Active config # in use will be displayed in status area)
- 4) **BUTTON 4**
- SHORT PRESS:** Selects ITEMS (sub-menus) within menus
IN METER ITEM SELECTION MODE (Long press right toggle center button to access): SELECTS METER CHANNEL SOURCE
- LONG PRESS:** SHORTCUT TO TIME BASE TIME/DIV
- HOLD BUTTON:** Toggles CURSOR RESTRICTED METER FUNCTION
"X" appears in status area when function is ON
- 5) **LEFT TOGGLE:** <LEFT-RIGHT> ADJUSTS SELECTED (FLASHING) MENU ITEMS
IN METER ITEM SELECTION MODE (Long press right toggle center button to access): CHANGES SELECTED (flashing) METER FUNCTION
- LEFT TOGGLE CENTER PRESS:**
- SHORT PRESS:** SETS TRIGGERING SOURCE CHANNEL
If only 2 channels are ON, TOGGLES BETWEEN THE TWO. If Menu is ON a channel, sets triggering to that channel.
If more than 2 channels are ON, acts as a SHORTCUT TO TRIGGERING SOURCE MENU (does not change source)
If CH-A AND CH-B ONLY are ON, will cycle CH-A > CH-B > CH-A&B
- ENGAGES SPECIAL CONTROLS IN SELECTED FUNCTIONS (Adjustment items will show in notification area):
IN WAVE OUTPUT MENU (FREQ RANGE SUB MENU) Toggles WAVE OUT SPECIAL FUNCTIONS (Sweep/burst adj)
IN WAVE OUTPUT MENU (% DUTY PWM SUB MENU) Toggles PULSE MODE/PULSE WIDTH ADJ
IN CH 1 MENU (COUPLING SUB MENU) :
In serial decode (RS232/TTL): Toggles SERIAL DECODE DATA/PARITY ADJUST
In SPI decode : Adjusts SPI parameters (shift between parameters with RIGHT toggle CENTER button
IN CH 2 MENU (COUPLING SUB MENU): In SPI decode, toggles decode data display chart
IN XY MODE: Toggles PERSISTENCE ON/OFF
IN T1-T2 MENUS while in SERIAL DECODE: Toggles AUTO (T2-T1) or MANUAL (T2+T1) MODE
IN NORMAL (TIME BASE SELECTED) PERSISTENCE MODE: TOGGLES RAW (non interpolated) MODE ON > OFF
IN FILE MENU: LOADS/SAVES FILE (When loading config, number in use will be displayed in status area)
- LONG PRESS:** WITH METERS ON > CHANGES METER PAGES (Note CH-A&B page is NOT CUSTOMIZABLE)
CH-A&B > CH-A > CH-B > CH-C > CH-D (Note when changing pages custom selected meter items will revert to defaults.
If saving custom meters is desired, save configuration, custom meter settings will be stored along with other parameters)
- WITH METERS OFF > Toggles WAVE CALIBRATION ON/OFF ("C" or "U" is displayed in status area)
- HOLD BUTTON:** TOGGLES TRIGGER HOLDOFF ("T" will show in notification area, position indicating relative delay. Color will be of channel color if in supported mode/timebase, greyed out if not)

6) RIGHT TOGGLE: <LEFT-RIGHT> SELECTS MENUS (HOLD LEFT to go to CH-A, HOLD RIGHT to go to FILE MENU)
IN METER ITEM SELECTION MODE: SELECTS METER FOR CUSTOM SETTINGS

RIGHT TOGGLE CENTER PRESS:

SHORT PRESS: TOGGLES BUFFER SIZE: SHORT (1 screen wide) > LONG (Approx 10 screens wide)

IN SPECTROGRAPH MODE SELECTS: SPEC > SPEC + ENVELOPE > ENVELOPE

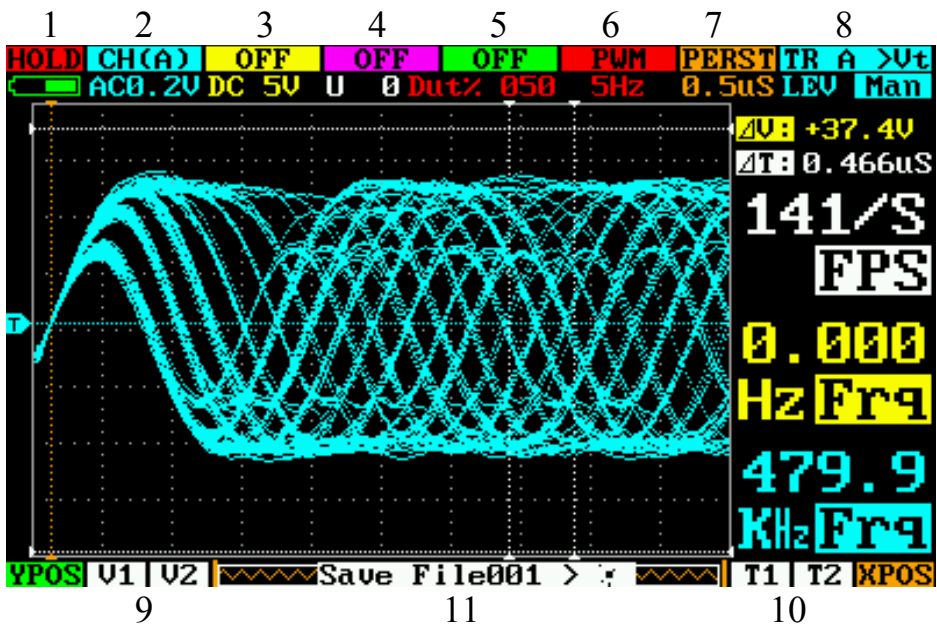
IN WAVE OUT SPECIAL FUNCTIONS MODE: CHANGES SPECIAL FUNCTIONS AND THEIR ADJUSTMENT ACCESS

IN SERIAL DECODE AND SPI MODES: SHIFT ACCESS TO NEXT PARAMETER

LONG PRESS: WITH METERS ON : TOGGLES NORMAL MENU SELECTION > METER ITEM SELECTION (For custom meter settings)
WITH METERS OFF: TOGGLES STANDBY TIMER ON > OFF

HOLD BUTTON: TOGGLES MIN/MAX HOLD FUNCTION ON > OFF (Meter MIN/MAX titles will show in WHITE when hold is on, values will show in selected channel color, "H" will also show in status area)

MENUS



STATUS AREA: BELOW CH C (4) IN WHITE
U or C - Wave calibration on (C) or uncalibrated (U)
H - Hold mode ON for Vmax and Vmin
X - Cursor selected meters ON
0-9 - Active config file in present use (0 is boot up config)

1) RUN/HOLD (display only) Displays RUN/HOLD status

<ADJUST ITEMS WITH LEFT TOGGLE> <CHANGE MENUS WITH RIGHT TOGGLE>
<CHANGE SUB MENUS WITH SHORT PRESS BUTTON 4>

>>>NOTE that once a sub menu ITEM has been selected, it will STAY when leaving and coming back to the menu. This is handy as it allows a quick selection between the items in different menus, however it may be confusing to first time users as the focus may seem to be flinging around randomly from place to place on the screen.

MENUS	SUB MENUS	ITEMS
2-3) ANALOG CH A AND B		
CH source:	OFF > CH(A) > CH(A)x10	(Displays CH-A=X or x10A=X, CH-B=Y or x10B=Y in XY mode)
COUPLING	AC > DC > DT > TL > RS > I2 > SP	(AC > DC > Detector mode > TTL serial decode > RS-232 serial decode > I2C decode > SPI decode)
VERT RANGE	50MV / DIV TO 10V/DIV in 1-2-5 steps	
Y POSITION	(Bottom left of screen)	

- 4)

DIGITAL CH 3

CH source

OFF > CH(C)

(NOTE THAT CH 3 IS DISABLED if trig source is A&B)

Y POSITION

(Bottom left of screen)
- 5)

DIGITAL CH 4

CH source

OFF > CH(D) > (A+B) > (A-B) > (C&D) > (C or D) > DAT_A > DAT_B > DAT_C > DAT_D > MAP > SPEC > hFFT_B (Hann window) > sFFT_B (Summing) > hFFT_A (Hann window) > s (Summing) FFT CH-A

(NOTE THAT CH 4 IS DISABLED if trig source is A&B)

FFT GAIN

(In notification area, only in FFT/SPEC Modes) LOG>AUTO > 0db > +6db >.....> +36db > +42db

Y POSITION

(In all other Modes, selection blinks at bottom left of screen)
- 6)

GENERATOR OUTPUT

WAVE TYPE

OFF > ARBTR > SINE > TRIANGLE > SAWTOOTH > SQUARE > PWM > NOISE

FREQUENCY

(RANGE) PWM= 1HZ TO 8MHZ ALL OTHERS= 1HZ TO 200KHZ

LEVEL/DUT%

PWM= DUTY 1% TO 99% ALL OTHERS= LEVEL 0 TO 2.6V P-P
- 7)

TIME BASE

SCAN MODE

TRIGGERING OFF > AUTO > NORMAL > NORMAL W/CLEAR > PERSISTENCE > SINGLE > XY

(NOTE that only NORM will show with A&B source)

TIME/DIVISION

1SEC TO .1uS In 1-2-5 steps

X POSITION

(Selection blinks at right bottom of screen) Shifts hor position of triggered waveform (In LARGE BUFFER MODE, notification area shows window POSITION within buffer)

PERS FRAMES

(In notification area, only in PERSISTENCE MODE) PERSISTENCE FRAMES: CONTINUOUS > VARIABLE FROM 1 TO 256 FRAMES

XY SAMPLES

(In notification area, only in XY MODE) BUFFER SIZE FOR XY MODE= VARIABLE FROM 256 TO 4096 SAMPLES
- 8)

TRIGGERING MODE

TRIG SOURCE

CH-A > CH B > CH C > CH D > CH-A&B

(Selecting CH-A&B as SOURCE disables digital channels)

TRIG TYPE

+ TRANSITIONS > - TRANSITIONS > LEVEL GREATER THAN CURSOR > LEVEL LESS THAN CURSOR > LOW LESS THAN DELTA T1-T2 > LOW GREATER THAN DELTA T1-T2 > HIGH LESS THAN DELTA T1-T2 > HIGH GREATER THAN DELTA T1-T2 > GEN

TRIG LEVEL

Adjusts triggering cursor level (NOT AVAILABLE IN AUTO TRIG MODE)

TRIG DELAY

(In notification area, if delay is enabled, only in NORMAL MODES, 1mS and slower and in single frame buffer mode only) Adjust trigger delay in steps of 1 major div. Shifts "T" indicator.
- 9)

VOLTAGE CURSORS

V1

Adjust top VOLTAGE CURSOR (Can be used to adjust parts of waveform to be included in meters in CURSOR SELECT METER MODE)

V2

Adjust lower VOLTAGE CURSOR (Can be used to adjust parts of waveform to be included in meters in CURSOR SELECT METER MODE)

In FFT mode, shows reference db LEVEL.

V SOURCE

Selects CH-A or CH-B as SOURCE to display in DELTA V display at top right of screen.
- 10)

TIME CURSORS

T1

Adjust left TIME CURSOR position (Can be used to select parts of waveform to be displayed in meters in CURSOR SELECT METER MODE, also adjusts START POSITION in SERIAL DECODE MANUAL MODE)

In FFT mode, shows FREQUENCY at position of cursor.

T2

Adjust right TIME CURSOR position (Can be used to select parts of waveform to be displayed in meters in CURSOR SELECT METER MODE, also adjusts BAUD RATE in SERIAL DECODE MODE)
- 11)

NOTIFICATION AREA/FILE MENU

LOAD/SAVE

LOAD FILE > SAVE FILE

FILE #

CHANGE FILE NUMBER

FILE TYPE

CONFIGURATION FILE > ARB > BMP > DAT > BUF > CSV (CSV only in SAVE MODE, ARB only in LOAD MODE)

OPERATION

CH A, B, C, D:

VOLTS/DIV SHORTCUT: LONG PRESS BUTTON 1 to access either CH A or CH B VOLTS/DIV sub menus. Also can be used to TOGGLE CHANNEL ON/OFF. See BUTTON FUNCTIONS section for more info.

Channels A and B are analog channels and have coupling and Y (vert) sensitivity range sub menus. Change SUB MENUS with BUTTON 4. ALL have Y position sub menus. CHANNEL C is a simple digital channel. CHANNEL D has MULTIPLE FUNCTIONS. In addition to selecting the channel D input, it can display the sum and difference of CH A and CH B, AND and OR LOGIC between CH C and CH D, traces saved in DAT file formats (after loading the DAT file, select REC_A, B, C or D), and selects FFT, SPECTROGRAPH and MAP displays. NOTE that SPECTROGRAPH and MAP displays WILL NOT SHOW ANYTHING unless either CH A or CH B are ON (CH A has precedence if both are on)

OUTPUT GENERATOR :

ADJUST WAVE TYPE by shifting output menu. OFF > ARBT > SINE > TRIANGLE > SAWTOOTH > SQUARE. Sine, triangle, sawtooth and square range is from 1hz to 200khz and can be ADJUSTED FOR AMPLITUDE by shifting sub menu to Vo (volts output). Best quality will be at maximum amplitude as internal digital background noise will become noticeable at the lowest settings. PWM (pulse width modulation) can be adjusted for DUTY% (Vo menu changes over to duty%) but cannot be adjusted for amplitude. Frequency for this wave type ranges from 1hz to 8Mhz. ARBT (arbitrary) wave range depends on number of samples, see “USING ADVANCED GENERATOR FUNCTIONS”. SHIFT FREQUENCIES (RANGES with variable control) with FREQUENCY SUB MENU. Shift to OFF when not using generator, some of the advanced functions take a considerable amount of processor resources and can slow down main scope operation.

VARIABLE:

CONTINUOUSLY SHIFT FREQUENCIES within each range by PRESSING LEFT TOGGLE CENTER BUTTON while FREQ RANGE MENU IS FLASHING. Frequency is displayed in notification area. (Shift back by pressing again) Adjust with LEFT TOGGLE STEPS of approx +/- 0.7%, increasing at the higher frequency ranges due to the limitations of the scaling dividers in the system. RANGE of approx +/- 1 octave above and below the selected range (4:1 ratio overall), the higher frequency ranges having lower high frequency limits due to sampling rate limitations of the internal DAC. Selected frequencies will be RESET to the range default when changing ranges.

SAMPLES PER PERIOD is 720 samples for frequencies of 2.5Khz and below, 360 for 5khz range, 180 for 10khz and 72 for the 20khz range, due to limitations of the internal DAC.

NOTE that a DC OFFSET is present at the wave out connector, regardless of the wave type or level. This may be desirable in some cases such as driving logic circuits but in other cases may need to be filtered out externally.

TIME BASE MODES:

TIME/DIV SHORTCUT: LONG PRESS BUTTON 4 at any time to access TIME/DIV sub menu.

NOTE that in A&B TRIGGER MODE, mode will be LOCKED in NORML. Previous selection will be restored upon exiting A&B source.

<TrOFF> Triggering and synchronization completely disabled, device will start new scan as soon as it reaches the right side of the screen.

<AUTO> Scans in normal triggered way. If triggering is lost, after an appropriate delay, will auto scan. Note that at low scan speeds, If monitoring relatively low frequencies, triggering may be lost as it may enter auto scan before being triggered again. If this happens, switch to <NORMAL> mode.

-NORMAL MODES: <NORML> Provides best triggering as after scan is complete, the device just waits for another trigger.

<NorCl> NORMAL WITH CLEAR: <NORML> mode leaves last scanned frame visible on screen while waiting for another trigger.

<NorCL> clears last displayed frame after a short delay. This can be useful for example to monitor a series of identical pulses. In normal mode, new pulses would just overwrite the old one and may it not be apparent a new event has occurred.

-PERSISTENCE MODE

SELECT <PERS> IN TIME BASE MODE: All traces will stay displayed on screen until manually reset if in CONTINUOUS MODE.

SELECT CONTINUOUS OR AUTO RESET NUMBER OF FRAMES: With menu in TIME BASE, cycle items with BUTTON 4 to how FRAMES= in notification area. Change with LEFT TOGGLE. At extreme left will be CONT (continuous). Shift to right to select: AUTO and NUMBER OF FRAMES to show until auto resetting.

RESET (if in continuous mode) by engaging ANY button or toggle. Freeze display with HOLD, then press again to reset.

PERSISTENCE MODE acts as a NORMAL mode, so will not show any display (or change) until triggered.

TOGGLE RAW MODE by SHORT pressing LEFT TOGGLE CENTER BUTTON. Raw mode turns off all interpolation, so that only data POINTS are displayed, with no lines connecting them. This can be useful in improving resolution when many waveforms are close to each other, since interpolation lines have a tendency to quickly cover everything up if too close. The first frame in RAW mode will nevertheless be displayed with interpolation to improve graphics, only subsequent frames will be displayed as data points.

-SINGLE

SELECT <SINGL> Display pauses after capturing a single frame. Reset with SHORT PRESS BUTTON 1

-XY MODE

SELECT <XY> IN TIME BASE MODE: Channel A is displayed along X axis, and channel B along the Y axis.

While in TIME BASE MENU, change items (BUTTON 4) to show SAMPLES= in notification area. Change number of samples with LEFT TOGGLE.

Range includes from 256 to 4096 samples, which corresponds to a frame rate of around 50 to 6 or so FPS. Faster frame rates (fewer samples) will result in a more "fluid" display with moving patterns, the faster a pattern is moving the faster is the frame rate necessary to follow it correctly. However, more samples improves the graphics, and if there are not enough samples the pattern may not be complete, showing a gap. If there are too many samples, the pattern may fold upon itself, showing multiple traces. In such a case shifting to a faster time base will correct this. A bit of experimentation with TIME BASE SETTINGS and SAMPLE NUMBERS will quickly show optimum settings for each display.

For STATIONARY PATTERNS, PERSISTENCE MODE can be used. SHORT press LEFT TOGGLE CENTER BUTTON to toggle mode. This will improve graphics as dots will quickly populate the display to form lines.

To SHIFT PATTERN POSITION use CHA XPOS to shift HORIZONTALLY and CHB XPOS to shift VERTICALLY

BUFFER SIZE:

Short press RIGHT TOGGLE CENTER BUTTON to toggle between buffer size of 1 frame or (approx) 10 frames. In single frame buffer mode, notification area rectangle will occupy the whole section, while in large buffer mode an appropriate sized rectangle will show the present position of the visible frame within the buffer. XPOS (sub menu of the time base menu) will shift the visible frame position within the buffer.

NOTE that screen refresh rates in large buffer mode will be extremely slow at the slowest time bases. METER ACCURACY will benefit from using the large buffer at slow time bases however.

NOTE that in SPECTROGRAPH MODE (only), this button has a different function.

TRIGGERING SOURCE:

TRIGGERING SOURCE SHORTCUT: SHORT PRESS LEFT TOGGLE CENTER BUTTON to set triggering source. An attempt will be made to set source to a relevant channel. See BUTTON FUNCTIONS for more info. NOTE that this button has several ALTERNATE FUNCTIONS depending on the menu selected.

In TRIGG MENU select TR A, B, C, D or A&B for triggering source channel. Selecting A&B will lock time base mode in NORML.

TRIGGERING LEVEL:

MANUAL TRIGGERING LEVEL SHORTCUT: LONG PRESS BUTTON 2 to put trigger level mode in MANUAL. Menu will shift to LEVEL and will change to MANUAL. Adjust trigger point with LEFT TOGGLE. As long as mode is in MANUAL, item can be selected to manually set trigger level.

AUTO TRIGGER LEVEL: SHORT PRESS BUTTON 2. MAN in trig sub menu will change to 1/2 (sets level to the middle of the waveform) SHORT PRESS AGAIN to set to 3/4, then 1/4 of wave level.

TRIGGERING TYPES

Change TRIGG MENU TYPE ITEM:

LEVEL BASED: >Vt <Vt Triggers when wave crosses over the TRIGGER CURSOR to above or below.

EDGE BASED: POS EDGE, NEG EDGE Triggers when wave crosses over the TRIGGER CURSOR on positive or negative edges

TIME BASED: LOW LESS THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor DOWN to the time it crosses the cursor BACK UP is SHORTER than the DIFFERENCE BETWEEN THE T1 AND T2 CURSORS ON SCREEN, the device will trigger when COMING BACK UP.

LOW GREATER THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor DOWN to the time it crosses the cursor BACK UP is LONGER than the DIFFERENCE BETWEEN THE T1 AND T2 CURSORS ON SCREEN, the device will trigger when COMING BACK UP.

HIGH LESS THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor UP to the time it crosses the cursor BACK DOWN is SHORTER than the DIFFERENCE BETWEEN THE T1 AND T2 CURSORS ON SCREEN, the device will trigger when GOING BACK DOWN.

HIGH GREATER THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor UP to the time it crosses the cursor BACK DOWN is LONGER than the DIFFERENCE BETWEEN THE T1 AND T2 CURSORS ON SCREEN, the device will trigger when GOING BACK DOWN.

GEN: Triggers after space between sweeps or bursts from generator, on first pos transition if above wave center or neg transition if below. If generator is set to a continous wave type, triggering in this mode is set to > VT

Note that it makes NO DIFFERENCE WHERE THE T1 AND T2 CURSORS ARE ON SCREEN, only the SPACING BETWEEN THEM. They can be positioned wherever it can be useful to gauge waveform width. Also note that if the time base is changed, the cursors will remain in the same relative spacing, while the "LOW/HIGH TIME" will change, potentially disabling triggering.

-A&B TRIGGER SOURCE

Selecting A&B as a trigger source will allow triggering on two completely different (frequency unrelated) signals simultaneously.

ONLY NORMAL TRIGGERING MODE is compatible with A&B source: Selecting A&B source will LOCK the device in NORMAL mode. DIGITAL CHANNELS also will be DISABLED. Previous settings will be restored when exiting mode.

CHANGING TRIGGERING LEVEL either in AUTO or MANUAL mode will affect both A and B trigger cursors equally. To change each independently shift SOURCE TO EITHER A OR B, change the level for that channel then return to A&B mode. Trig cursors will remain where set relative to each other.

-DELAYED TRIGGER MODE:

ONLY AVAILABLE IN NORMAL MODES AT TIME BASES OF 1mS/DIV AND LOWER IN SINGLE FRAME BUFFER MODE

HOLD LEFT TOGGLE CENTER BUTTON to toggle mode. "T" shows in notification area on buffer display at approximate position of delay. If in supported mode/time base, indicator will show in color of triggering channel, otherwise will be grayed out.

TO CHANGE DELAY: From TRIGG menu change items to select blinking "T" indicator. Move LEFT TOGGLE right to increase delay or left to decrease in steps of 1 (major) screen division.

NOTE that at faster time bases or different triggering modes, much of the functionality of a delayed trigger can be had using the time based trigger types. At time bases faster than 1mS/div timing integrity is lost, as frame rates cannot keep up with incoming signal, so adding extra delay becomes meaningless. At the very fastest time bases, for example, only a very small portion of the incoming data stream is captured. The lost data period is known as "Dead Time" and is inherent in all but the most expensive instruments available, with more expensive devices offering faster display frame rates and less dead time.

METERS:

Select meter mode by SHORT PRESSING BUTTON 3. Cycles NO METERS > SMALL METERS > LARGE METERS.

In all meters the color displayed is the color of the source channel. Meters displaying in WHITE are either GLOBAL, not relating to any particular channel (display brightness, battery voltage, etc) . HOLD MODE for V MAX AND V MIN meters also show in WHITE.

In SMALL METER MODE:

The 5 top meters will always be, from the top:

-DELTA-V: Shows the difference in voltage, relating to the present selected range, between the V1 and V2 cursors. Change the SOURCE CHANNEL for this while in the V cursor menu (shift RIGHT TOGGLE until V1 or V2 at the bottom of screen flashes) Then use BUTTON 4 to cycle V1 > V2 > DELTA V. When DELTA V FLASHES, you can use the LEFT TOGGLE to select either CH A OR CH B. The display will change to the source color for the selected channel.

-DELTA-T: Shows the difference in time, relating to the present time base, between the T1 and T2 cursors.

-BACKLIGHT: Shows the display brightness level. Select this using the RIGHT TOGGLE. When this meter flashes, backlight can be adjusted with the LEFT TOGGLE.

-VOLUME: Shows the level of the buzzer. Select this using the RIGHT TOGGLE. When this meter flashes, buzzer volume level can be adjusted with the LEFT TOGGLE.

-BATTERY VOLTAGE: For display only,

In LARGE METER MODE:

-Only DELTA-V and DELTA-T will persist on all meter pages, except for the preset page showing only 2 large meters which will also show the same small 5 meters as described above.

METER PAGES:

Change between the 5 meter "pages" by LONG PRESSING LEFT TOGGLE CENTER BUTTON. One page is preset and cannot be changed and will show only 2 meters in large meter mode. LONG PRESS again to access 4 customizable pages, each preset to favor one of the channels.

CUSTOMIZABLE METERS:

BOTTOM 9 REMAINING METERS (3 in large meter mode) can have their items and source changed.

LONG PRESS RIGHT TOGGLE CENTER BUTTON to change focus from the regular menus to the meters. Use RIGHT TOGGLE to select meter to customize. LEFT TOGGLE will CHANGE METER ITEMS. SHORT PRESS BUTTON 4 to change METER ITEM SOURCE (meter color will change to the channel's color).

LONG PRESS RIGHT TOGGLE AGAIN to revert to regular menus.

NOTE that depending on the source, some items may not be available (eg: DC volts from digital CH C or D)

>> ALSO NOTE that while you can change from large to small to no meters without affecting custom meter settings, CHANGING METER PAGES will RESET custom settings. IF IT IS DESIRED TO SAVE CUSTOM METER SETTINGS, save the settings to one of the additional CONFIG FILES. Meter settings of the displayed page will be restored upon reload, along with all other settings.

-METER ITEMS:

Customizable items that meters can be set to display: (color indicates source channel selected)

NOTE that only time based items can be displayed with digital channels.

- Voltage ranges displayed: mV, V
- Frequency ranges displayed: mH, Hz, Khz, Mhz
- Time ranges displayed: nS, uS, mS, S

- Vbt = Battery voltage
- FPS = Frames per second. Display refresh rate (note that at the slower time bases, frame rates will be faster than data refresh rates)
- Vdc = Average voltage of the displayed waveform
- RMS= Effective DC equivalent of an AC waveform (note that this includes any DC offset present with the waveform)
- Frq = Frequency of displayed wave (Needs to have at least one complete period within display, starting with a positive alternation)
- Max = Maximum voltage attained by waveform from entire buffer.
- Min = Minimum voltage attained by waveform from entire buffer.
- Vpp = Maximum peak to peak waveform voltage
- Per = Time span of one complete measured waveform, averaged from all waves in entire buffer
- Dut = % duty cycle, time waveform was above mid point in relation to when it was below
- TH = Time waveform was above mid point within one complete measured waveform, averaged from all waves in entire buffer.
- TL = Time waveform was below mid point within one complete measured waveform, averaged from all waves in entire buffer.

-CURSOR SELECT METERS

To toggle mode HOLD BUTTON 4 until notification appears. An "X" will be displayed in status area with mode active. All meter readings will be restricted to between the time cursors T1 and T2. For frequency and time meters, at least one positive alternation followed by a negative alternation must be enclosed for the time meters to register. The "trigger point" in calculating time measurements will be half way of the peak to peak value of the enclosed signal. This can be changed by using the V1 and V2 cursors. The V1 cursor, if brought down below the middle of the signal, will lower the trigger point as it goes down below it. Similarly, the V2 cursor if brought up above the trigger point, will raise it. The V2 cursor has precedence over V1, so if V1 is brought down below V2, V2 if brought up, will define the trigger point for measurements.

T1 and T2 can independently be disabled while in this mode by bringing T1 all the way to the left of the screen, or T2 all the way to the right of the screen. With T2 all the way right, all data to the end of the buffer is included, if T1 is all the way left all data from the start of the pre-trigger section (150 samples before the trigger point indicator vernier) will be included. Works whether in RUN or HOLD, and at all Xposition settings in both buffer modes (long or single frame). In DETECTOR mode, cursor select mode will show a frequency display at the bottom of the screen (see using advanced gen functions)

-MIN/MAX METER HOLD MODE, ALARMS

HOLD MODE allows the HIGHEST/LOWEST displayed values to be recorded and saved. To toggle, HOLD RIGHT TOGGLE CENTER BUTTON until notification appears. "H" will be displayed in the status area when mode is active. MIN and MAX items in meters will show in WHITE. Values will show in SOURCE COLOR. Press HOLD, then RUN to RESET. Changing any parameter which is related to Y display will also reset function (eg: Y range, Y pos, etc). Changing buffer size will also reset function. ALARMS are also ENABLED in this mode. When waveform either goes ABOVE V1 or BELOW V2, buzzer will sound as long as the waveform is either above or below, and for approx 1 second after. DISABLE ALARMS: Move V1 cursor to the very top of the screen to disable it, and disable V2 by moving it to the very bottom of the screen.

CURSORS:

Shift menu selection with RIGHT TOGGLE until V1/V2/DELTA-V or T1/T2 are selected. Change items with BUTTON 4. Shift cursor positions with LEFT TOGGLE. With DELTA-V selected, SOURCE CHANNEL of the display can be changed with LEFT TOGGLE.

NOTE THAT CURSORS HAVE ADDITIONAL FUNCTIONS:

- IN TIME BASED TRIGGERING TYPES: The difference in position between T1 and T2 determine the reference to whether a low/high pulse is either shorter or longer than to trigger on.
- IN FFT MODE: T1 can be used to indicate frequency. V2 can be used to indicate level in decibels.
- IN CURSOR SELECT METER MODE: T1 and T2 can select which part of the waveform to measure. V1 and V2 can be used to select which part of a waveform the frequency and time meters respond to.
- IN SERIAL DECODE MODE: The difference between T1 and T2 sets the baud rate. In manual mode shifting either will shift both together so start position can be changed without changing baud rate.

TRIGGER LEVEL CURSORS will show with a "T" on left side of screen in color of the selected channel. Adjust while in manual mode with trigg menu item LEV with LEFT TOGGLE.

TRIGGER POINT CURSOR is an orange vertical cursor that shows the exact point when the device triggers on the signal. It's position can be shifted from the center of the screen towards the left with the LEFT TOGGLE while XPOS is selected.

FILE FUNCTIONS:

SHIFT MENU ALL THE WAY TO THE RIGHT using RIGHT TOGGLE to access the file menu. Toggle can be just held right until it stops. With BUTTON 4 select LOAD/SAVE > FILE# > FILE TYPE (BMP, DAT, BUF, CSV, CFG) CHANGE ITEMS with LEFT TOGGLE. EXECUTE file operation by PRESSING LEFT TOGGLE CENTER BUTTON

- SAVE BMP for a screenshot of the device. Can be exported via USB or loaded back into the device to display.
- LOAD BMP to view saved screenshots.

-SAVE DAT files save the screen trace buffer from all 4 channels. Only what is visible on the screen is saved.
-LOAD DAT loads saved screen buffer traces into CHANNEL D <REC_A> <REC_B> <REC_C> <REC_D> buffers. Selecting these from the CHANNEL D MENU SOURCE will display one of the 4 channels.

-SAVE BUF saves the entire buffer (1 screen in single screen buffer mode or ~10 screens in large buffer mode) for all 4 channels along with the relevant time base and channel range information.

-LOAD BUF loads a saved buffer file and puts the device in HOLD for displaying. If saved from a large buffer, XPOS can be used to scroll the window through the buffer. Engaging RUN will exit display and return to previous settings.

-SAVE CSV saves a comma delimited numerical readout of all 4 channels from the entire buffer. Use for exporting trace data to external programs to reconstruct waveforms.

-LOAD ARB loads a comma delimited text file with a sequence of numbers defining output of the arbitrary wave generator function. Output type selected must be ARBTR before loading the file for this to have any effect.

-SAVE CFG saves an alternate config file that can be recalled later to restore the saved settings. Up to 9 of these can be saved, in addition to the default boot-up config. A number in the status area shows the presently loaded config. #0 will always be the default boot config (XXXX.WPT) while the additional files have a CFG extension. Note that in order to save these, a file must already exist on the drive so it can be overwritten. SEE "SAVING CONFIG FILES" below. HOLD BUTTON 3 for a shortcut to SAVE CONFIG, then press BUTTON 3 AGAIN to save. Default will save file #0; change number with left toggle to save to an alternate file before pressing button 3 again if desired

-LOAD CFG will restore previously saved settings. LOAD CFG#0 with the file# flashing will be the default file menu setting after boot-up. This makes it easy to select alternate configs: just hold RIGHT TOGGLE right until menus stop, CHANGE CONFIG NUMBER with LEFT TOGGLE if desired, then press LEFT TOGGLE CENTER BUTTON to load. File menu will stay with numbers highlighted, making it easy to "browse" though other configs. OR press BUTTON 3 to load and restore menu selection saved with config.

-SAVING MULTIPLE CONFIG FILES:

In order to prevent file corruption on earlier devices (with SYSTEM files PRIOR to V 1.60, this generally means all devices with 2Mb drives that have not been patched with Alterbios) which had improperly written file functions, the program will only write additional configs (NOT the default WPT) if a file already exists. This is a workaround to prevent corruption: WPT and BAK files are first saved on an external machine via USB, then the drive is formatted with a Windows machine. The WPT and BAK files are then copied back onto the device, followed by 9 copies of the WPT files, renamed CONF001.CFG though CONF009.CFG. This needs to be done before ANY other files are saved on the device after formatting. This puts these files at the start of the file allocation table, and with no chaining data because of their small size, their entries in the FAT remained safe, corruption only occurring further down the table. Earlier devices with this problem should be patched with Alterbios to fix this issue and prevent additional files from getting corrupted.

-CORRUPTED CONFIG (WPT) FILES:

As a result of the above mentioned file corruption problem, new system versions (V 1.60 and above) were created to fix this. While the new versions appear to be compatible with all devices (and programs) many, if not most of these were installed on newer ones with 8Mb drives. Unfortunately, writing files to 8Mb devices requires additional code in the programs. If an older version program designed to work only with 2Mb devices is loaded on a 8Mb device, file operations will fail, resulting in corruption. If a config file gets corrupted as a result of this, even a program compatible with 8Mb devices can crash upon boot-up loading the corrupted file. In order to preserve compatibility of saved settings with older versions, this program uses the same WPT config files as the older programs that came from the factory. Later programs with 8Mb compatibility appear to use config files of a different extension, so they should be compatible running together with this program, but loading earlier programs that use WPT files on the same device should be avoided.

FFT MODE

FFT mode is part of CHANNEL D. It can quickly be accessed by moving left toggle left while in CH D menu, if set to OFF. You can scroll backwards: hFFT channel B < sFFTchannel B < hFFTchannel A < sFFTchannel A < OFF
2 window modes are available: Hann (h) or Summing (s).
The SUMMING MODE is not actually a window, but a function that sums any detected peak with it's neighbors. This provides an absolutely flat frequency response, at the expense of the two frequencies above and below the peak. For most measurements this won't be noticed, and is the preferable mode to use. When displaying signals of constantly varying frequency (such as music), the "every other frequency missing" notches may be apparent. In such cases it may be preferable to use the Hann window. It should be noted that in this mode, ALL frequencies CAN be displayed. Only where there is a peak are the neighboring frequencies restricted.

FFT GAIN can be adjusted by a factor of 42db. Dynamic range is such that even with +42db gain setting, a full scale waveform will not overload.
TO ADJUST FFT GAIN, while in the CH D menu, and in any FFT/SPECTROGRAPH mode, press BUTTON 4 to change menu items. Instead of changing to YPOS, a gain display will show in the notification area. Use left toggle to change. Selecting towards the left will show AUTO. In this position, gain setting will automatically change in relation to the signal level. For constantly changing waveforms (music for example) or to gain extra resolution with large amplitude signals, switch over to manual settings, (0 to +42db in 6db steps).
LOG AMPLITUDE SCALING can be selected in notification area gain menu LOG > AUTO > 0db > +6db > > +42db
In FFT mode, V2 CURSOR functions as a level reference (shown at top of screen). Value for this as well as the db scale on the right will change with different gain settings. In a similar way, T1 cursor can be shifted to indicate frequency.
NOTE that the frequency displayed on peaks is not the frequency of the signal but the "bin" center frequency. Bins at the far left carry a RELATIVELY wide range of frequencies and may not show the exact frequency of the signal. Accuracy will improve for peaks away from the left edge.
PERSISTENCE MODE: If this is engaged while in FFT mode, will act as a "peak hold", as all display frames will stay on screen. Reset with any button, or freeze with HOLD and press again to reset. Note that in this mode, the "floating" peak frequency display and red indicators will be disabled, as any reference to the actual peak will be lost.
TO DISABLE PEAK FREQUENCY READOUT AND INDICATORS: Shut meters off. Readout will only show with meters on. This may be desirable for example when displaying music, as the indicator will be doing much flinging around.

SPECTROGRAPH

THIS IS ALSO PART OF CH D: In DIGITAL CHANNEL D MENU, select SPEC. Either channel A or channel B MUST be turned on, and selects the input for this mode. If BOTH are ON, CH A has precedence and will be displayed.
SPEC MODE displays the FFT frequency spectrum on vertical rising lines, one for each frame. The COLOR at any given point defines the LEVEL, from dark blue > cyan > white > red as the amplitude rises, and the HEIGHT defines the FREQUENCY.
TO DISPLAY ENVELOPE: SHORT press RIGHT TOGGLE CENTER BUTTON to cycle SPEC > SPEC WITH ENVELOPE > ENVELOPE ONLY.
A MOVING CURSOR (short yellow line) will display at top of screen to show scan position, frequency scale at the left and seconds "ticks" will be displayed in all but the slowest time bases.
ADJUST GAIN and scaling in the same way as with FFT GAIN adjust. Does not affect envelope level.

MAP MODE

CHANGE CHANNEL D MENU TO MAP. Either channel A or channel B must be turned on, and selects the input for this mode. If both are ON CH A has precedence and will be displayed.
MAP MODE displays normal oscilloscope waveform level as a changing COLOR, each frame on a single horizontal line, so therefore has the ability to display 200 simultaneous frames. COLOR varies according to signal position on screen, with bottom of screen showing as black or dark blue, middle as cyan, and top as white or red. Note that adjusting Y POSITION CHANGES THE BACKGROUND, if no signal is displayed or changes the signal mid-point color if a signal is displayed.

WAVE CALIBRATION ENABLE/DISABLE

Toggle WAVE CALIBRATION ON > OFF with LONG PRESS LEFT TOGGLE CENTER BUTTON WHILE METERS ARE OFF. "C" for calibrated or "U" for uncalibrated will display in the status area. Turning calibration OFF can be useful to preserve waveform quality. Calibration compensation is accomplished by introducing "steps" along the waveform, increasing or decreasing amplitude. Under some conditions these can be visible and detract from showing an accurate display of the monitored waveform. Has NO EFFECT on METERS, these show calibrated values at all times.

STANDBY CONTROLS

Device will by default engage standby mode whenever no buttons have been pressed/toggled for 10 minutes. Press any key to resume from standby, key will not perform any other function. When engaging STANDBY with GENERATOR ON device will only DISABLE the scope, minimizing jitter caused by scope operation when the device is used only for it's generator functions.
When powering/charging device from an AC adapter/USB standby is disabled.
MANUALLY ENGAGE STANDBY (or disable scope if generator is on) with LONG PRESS BUTTON 3
TOGGLE STANDBY TIMER ON/OFF with LONG PRESS RIGHT TOGGLE CENTER BUTTON while meters are NOT SHOWING.
This setting is NOT saved when saving config, will reset to default standby enabled after reboot.

USING ADVANCED GENERATOR FUNCTIONS

-Sweep and burst modes are available for all wave types except noise and arbitrary.

-SWEEP AND TONE BURST GENERATOR: While in OUTPUT MENU, FREQ sub menu, SHORT press LEFT TOGGLE CENTER BUTTON to display special generator functions. SHORT press RIGHT TOGGLE CENTER BUTTON is then used to cycle through FREQ ADJUST > FREQUENCY SWEEP PERIOD > TONE BURST RATE > TONE BURST DURATION > TONE BURST FREQUENCY > back again to FREQ ADJUST. Relevant value will be displayed in notification area. Change values with LEFT TOGGLE.

TONE BURST RATE and TONE BURST DURATION are shown in same display, use LONG press RIGHT TOGGLE CENTER BUTTON to go backwards from BURST FREQ to BURST DURATION to TONE BURST RATE if necessary.

While in sweep mode or burst mode, output display will show in WHITE. In continuous, arbitrary or OFF mode, display will show in RED.

All modes will remain AS SET if menu is shifted away and will be saved with configuration. When not using generator, shifting wave type to OFF will allow all resources to be available to scope function and provide best performance.

-TRIGGERING on sweep and bursts can be facilitated by selecting "GEN" mode in triggering type menu. In this mode, triggering is set to trigger after the time span between sweeps or bursts, on the first positive transition if the trigger cursor is above the wave center, or the first negative transition if it's below. NORMAL SWEEP MODES should be used, as auto mode can time out between sweeps/bursts and cause instability. AC COUPLING should also be used if DC from the generator is present at the input, as it will prevent the program to find the wave center. ALSO, in this mode, auto trig is restricted to 1/4 and 3/4 level of wave as a transition may not be detected at the half way point. MAN trig level gives best results since spaces between sweeps/bursts can cause auto trigger instability.

GEN menu selection COLOR will change from channel color to GRAY if the combinations of settings (most likely timebase) or hardware limitations (eg: max time between sweeps > 4096 samples, limited by 12 bit variable in FPGA) can't guaranty triggering even if trigger level is properly set. In such a case, triggering may work ok but may not as certain settings are changed. In such a case, change timebase until GEN changes back to channel color.

-RANDOM NOISE MODE: Shift wave type to NOISE. Change bandwidth with FREQ sub menu. Noise mode is not adjustable as to output level. At 20Khz and below, noise is filtered with a 10X oversampling filter, below 1Khz with a 100X oversampling filter. Above 20Khz no filter is used and the generator will output raw digital samples.

-PULSE MODE: Shift mode to PWM continuous (shift output function using left/right toggle center buttons if necessary to move out of sweep or burst modes). While in OUTPUT MENU change sub menu to %DUTY using BUTTON 4. Adjust %DUTY with LEFT TOGGLE to the approximate value desired (for very short pulses this can be set to either 0% for positive pulses or 100% for negative pulses). While in %DUTY sub menu SHORT press LEFT TOGGLE CENTER BUTTON to access PULSE LENGTH display in notification area. This also engages pulse mode. Note that engagement of this mode is NOT saved with config files. Adjust pulse length with LEFT TOGGLE. For large changes, shift back to %DUTY with LEFT TOGGLE CENTER BUTTON, then back again to set to desired length. If %duty is less than 50%, pulse length will show as +value, if more than 50% length will show as a negative pulse length value, decreasing as the setting approaches 100%.

-While in PULSE MODE, repetition rate (frequency) can be adjusted by shifting sub menu to FREQ and changing range or by engaging the VARIABLE FREQUENCY DISPLAY in the notification area. Pulse length will not be affected by changing frequency. If very small values are used and the frequency is shifted to lower values, length might then increase if the set values are less than the minimum values supported. Also, while shifting ranges, some set length values may shift very slightly longer/shorter as different available division ratios are engaged.

-ARBITRARY WAVE MODE: First shift wave type to "ARBT". Then access file menu, select LOAD, ARB type and load desired file. Change frequency range and adjust frequency in the normal way. ONLY FREQ sub menu and FREQ ADJUST mode with display in the notification area are supported in this function. Wave will stay in memory until a different wave type is selected. Maximum frequency range available will depend on the number of samples used.

-GENERATING ARBITRARY WAVE FILES: This is a plain text file with a sequence of numbers ranging from 0 (max neg value) to 4095 (max pos value). Commas are used to separate the numbers as in a CSV (comma separated values) file. They can be generated manually or with any program that can create these type of files. Compilers and interpreters for example can easily write a math formula or algorithm as a sequence of numbers to a file. The program will ignore any whitespace or other characters other than numerals or commas. 3 simple rules apply: 1) First value MUST define how many samples are used. This can be anything from 2 to 720 samples. 2) There MUST be at least as many following numbers describing the wave as the first sample number indicates. If there are not, the program will generate an error upon loading. If more are present the program will simply ignore the surplus. 3) The last value MUST be followed by a comma. Programs that generate these types of files typically do NOT add a comma after the last field, so this may have to be added manually with a text editor. Alternatively, an extra value could just be added.

FOR EXAMPLE: The simplest waveform would be a square wave and could written like this: 2,0,4095, and would be a full amplitude square wave with a frequency adjustable from 1Hz to 900Khz.

SAVE or RENAME the file with a filename in the format of DATAxxx.ARB where xxx can be anything from 000 to 999.

DETECTOR MODE

USING DETECTOR MODE TO DISPLAY FREQUENCY RESPONSE:

- 1) Engage sine sweep mode: Shift generator menu to SINE, then with sub menu on FREQ short press left toggle center button to turn on special functions. Short press right toggle center button to shift to sweep mode (notification area will show sweep period adj).
- 2) Set scope sweep to NORMAL (auto mode can time out between sweeps and cause instability)
- 3) Set triggering to GEN
- 4) Set chA or chB coupling mode to DT and turn on channel.
- 5) Set buffer to single frame at first: Quickly scan all frequencies by shifting generator freq range. Entire sweep for range will be contained within window. Xpos may need to be shifted to the extreme left on some of the ranges to show entire sweep.
- 6) With a signal from the generator fed back into chA or B, freq response curve should be visible. Adjust vert range, Y pos, and trig level if necessary. Note that AUTO trig level in GEN mode with sweep on is restricted to 3/4 and 1/4 only. MAN works best for this function and can be used to "lock" 3/4 level after selecting it by engaging MAN with button 2 long press. 1/2 level or close to wave center should be avoided as scope needs to trigger going either above or below this point, so if trig level is too close to the center line triggering will not know which way to go.

-To allow program to auto set, change frequency RANGE with output menu on FREQ. Make sure to adjust freq and not special function parameters (eg: sweep period). In other words, ADJ parameters should NOT be displayed in notification area, if necessary, short press left toggle center button to go back to FREQ.

-When changing frequency range in this manner (with at least one channel on in detector mode and sweep mode with one of the analog waveforms selected) the program will automatically adjust SWEEP PERIOD and SCOPE TIMEBASE to properly display response curve. Entire frequency range can be quickly scanned this way to find relevant area of response curve.

-To get BETTER RESOLUTION, shift buffer to FULL. In the same way as with single frame buffer, changing frequency range will adjust sweep period and timebase automatically for a wider displayed sweep appropriate for a full buffer. Xpos will be now be necessary to be used to view entire sweep. Note that more than 1 sweep or a partial 2nd sweep may now be visible at the right after shifting Xpos.

-SWEEP PERIOD and TIME BASE can be manually adjusted, if desired, keeping in mind the program first adjusts the sweep period, then timebase to match. Therefore, sweep period can be manually adjusted without changing frequency range, but timebase will be readjusted. Finally, timebase can be then adjusted without anything else changing.

-To display FREQUENCY SCALE, move T1 and T2 to center, or somewhat a bit right of center with distance between the two at something like 1 to 2 divisions. Readings will be displayed no matter where the cursors are but accuracy will be best if they are close to the middle. THEN HOLD BUTTON 4 DOWN to engage CURSOR RESTRICT FREQ METER. Note that meters do not have to be showing but it may be useful to have meters on for monitoring since a frequency meter for the channel triggered on must be available. Once freq readout is gained, the program will extrapolate a frequency scale at the bottom with a readout at each division. ALSO NOTE that scale is estimated, particularly in single frame buffer mode, with accuracy typically within +/- 2 to 3%. For best accuracy, shift to full buffer mode and a properly expanded sweep, or position cursors around position of interest and read FREQ meter. The distance between the two T cursors must be wide enough to contain at least one complete wave or a reading will not be obtained.

-It may be advantageous to save such a configuration to one of the extra available positions to quickly recall if desired.

-PWM wave type CAN be used in detector mode, but noise and aliasing artifacts will become significant at the higher frequencies. PWM inter sweep level will be shifted from 0 (as is normal for this mode) to ½ of the wave amplitude and duty set to 50%; however auto setting of sweep period and timebase will NOT work using PWM waveforms. Settings will have to be made manually.

SERIAL DECODE

-This is only available using analog channel A: With menu on CHA, change item to COUPLING, then using LEFT TOGGLE cycle AC > DC > DET > TL > RS and select either TL (TTL, for positive logic) or RS (RS232 for inverted logic). Coupling will be set to DC in both modes. Notification area will show BAUD RATE, DATA LENGTH AND PARITY (N for none or P for any type). While in CHA MENU, and COUPLING blinking, short press LEFT TOGGLE CENTER BUTTON and adjust DATA size with LEFT TOGGLE: change from 5bits >>> 8bits with no parity > 5bits>>> 8bits with parity. To return to coupling press LEFT TOGGLE CENTER BUTTON again. FFT, spectrograph and MAP modes must be OFF.

Set timebase mode to NORMAL or SINGLE, buffer to FULL if more than just a few bytes are expected and other parameters to properly display waveform in top half of screen (bottom half is used to display characters/hex data). BAUD rate RANGE is changed along with the normal scope timebase: select timebase to properly display signal, then shift menu to T1-T2 ADJUST. Baud rate is set by changing distance between T1 and T2. Cursors can be anywhere, only the distance between the two is relevant. It can be useful though to set T1 at start of wave: for example, if baud rate is unknown, T1 can be positioned at start of waveform (start bit) and T2 moved to approximate character frame length, defined as number of data bits + 2 (start and stop bits) + 1 parity bit if present. Extra stop bits are ignored. Once rate is within approx +/- 5% of correct value the decoder should synchronize and show a valid display.

Timebase used in relation to baud rate will determine how many characters are displayed: selecting slowest time base possible while retaining a clearly defined waveform (with T1 and T2 around 1 division apart) will allow the maximum number of characters to be displayed (max is 96). Conversely, speeding up timebase will allow for a clearer waveform but will restrict the size of data displayed.

SYNCHRONIZING ON CONTINUOUS STREAM:

The decoder should synchronize on a continuous stream, provided enough characters are decoded. A "continuous stream" meaning a stream interrupted at some mid-point, where the start character/byte is unknown. This will also depend on the type of data captured; if a continuous stream of a same particular byte value is sent, for example, depending on the value, the program could confuse data bits for stop bits and improperly decode them. In such a case, first set data size, parity and baud rate. Then manually define the first start bit: With menu on T1-T2, short press LEFT TOGGLE CENTER BUTTON to engage manual mode (notification display will change from T2-1=BAUD to T2+1) and shifting left toggle will move BOTH T1 and T2 together, keeping the baud rate as set. T1 will now define the first decoded start bit, shifting it along the data stream should show a point, along a decoded byte where synchronization is correct. The "T2+1" display color will change to help identify when in sync, but in some conditions, such as when very few or many of the same characters are displayed causing the decoder to sync on the data rather than on start/stop bits it may be necessary to observe the data itself.

DECODING PAST 96 BYTES:

It is possible for the buffer under some conditions to hold up to 150 bytes of data. These can be decoded by advancing XPOS to the end of the 96 byte decoded portion, engaging manual mode and shifting the T cursors. Decoding will then start at this position and display the rest of the data.

Captured data can be quickly saved in "BUF" format: The menu can be kept on file and consecutive captures written to file with one button push. Reloading each buffer file will decode the data. Alternatively, BMP screenshots can be saved, and will show decoded data but these take longer to write.

NOTES:

Fastest usable timebase for RS232/TTL decoding is 5uS/div (possibly 2uS) due to lack of support for the interpolated timebases. This was on the assumption that decoding of this protocol at rates much faster than 1Mbit would not be needed.

When selecting 9 bits for decoding, then 9th (MSB) is simply discarded. The 9 bit selection is included only to allow proper synchronization. The status of this bit can be observed from the waveform, if necessary and will be located to the left of the stop bit, which is above the right byte location arrow “>”. The same holds true for the Parity bit.

USING I2C DECODE:

Connect the DATA line to CH A and the CLOCK line to CH B. Set CH A COUPLING sub menu to I2, and ALSO CH B COUPLING sub menu to I2. Time base mode works best set to NORMAL or SINGLE. AUTO can be temporarily used to view signal if not triggered in normal mode. Setup triggering and time base to properly display CH B clock signal. Level triggering set to neg transition usually works well, time based triggering on inter-packet spaces can also be used to advantage. Manual trig level works best as these signals tend to come in bursts. Move both channels up into the top half of the screen as bottom half is used to display buffer data.

NOTE that the triggering level must ALSO BE PROPERLY SET FOR THE DATA CHANNEL. As a reminder, the trig level arrow at the left of the screen for Ch A will remain while triggering is set to the Ch B clock. To adjust this, the trigger source needs to be set to CH A and adjusted in the normal manner. This sets the point at which the data is sensed changing HI/LOW and can be fine tuned to eliminate the effect of noise, ringing or other waveform distortions if necessary (for example a drooping positive transition on the signal lines from weak pull-up resistors can be compensated for by bringing the trig levels down towards the base line)

Bytes displayed with first clock sequence or restart sequence will be the SLAVE ADDRESS and are displayed in PURPLE, with the associated ASCII display showing "ad". 10 bit addresses occupy 2 bytes: the first will be the 2 most significant bits of the address in byte "XX" format (0 to 3) while the second contains the remaining 8 bits. Bytes not colored purple are data. The byte location frame indicators "< >" show the direction of data flow, with the right arrow highlighted indicating master to slave transfers and a left highlighted arrow indicating a slave to master transfer. The color of the highlighted arrow further signifies the ACK (GREEN) or NACK (RED) bit associated with each byte.

Bottom of screen displays the content of the buffer in ASCII and HEX format.

USING SPI DECODE: *NOTE that to if using Ch C as clock, devices prior to HW V2.72 should have protection diodes at the digital inputs removed as these severely limit the bandwidth and timing, and will cause decoding to fail at all but the lowest frequencies.*

Connect the 2 data lines (MOSI and MISO) to CH A and CH B. The clock signal is normally connected to CH C, but can also be connected to CH B, in which case only one of the two data channels will be displayed. If CH C is turned OFF, the program will use CH B as a clock. In SPI mode, the word and ASCII waveform location indicators sit just below the 0 baseline of the channel, and move up/down with the waveform as the Y position is changed. CH D can also be connected to the relevant slave select line. Triggering can be set to either clock (Ch C or Ch B) or slave select, if connected. The BUFFER CHART displays both data channels and can overwrite the entire display, depending on the amount of data, and is toggled ON/OFF from the CH B COUPLING ITEM with the LEFT TOGGLE CENTER button. If word length has been set MANUALLY to either 7 or 8 bits, ASCII data will be displayed on the chart in addition to HEX, otherwise only HEX data will show. Data is displayed in relation to the waveform positions, if Ch B waveform is above the Ch A waveform, top display is of Ch B, bottom Ch A. If Ch A was above Ch B then Ch A data will be above.

NOTE THAT TRIGGERING LEVELS MUST BE PROPERLY SET ON BOTH ANALOG CHANNELS.

Trig level arrows at the left of the display will be displayed as a reminder. Change by selecting with trig source and adjusting in the normal way. Trig level defines the HI/LOW change point for the clock/data pulses and can be moved up/down the waveform to eliminate noise, ringing, etc.

Set BOTH CH A AND CH B COUPLING MODES TO SP.

Set trig mode on MANUAL and time base/trig controls to properly display the clock signal. The SPI SETUP MENU is accessed by selecting the CH A COUPLING sub menu. Relevant parameters to be adjusted will be displayed in the notification area. Press LEFT TOGGLE center button to shift cursor to the notification area. Change items to be adjusted by pressing the RIGHT TOGGLE center button. The CHART DISPLAY is toggled by shifting to CH B COUPLING menu while set to SP and pressing LEFT TOGGLE button. Note that the chart display text overwrites the waveform and will not show unless data is captured.

INFORMATION ABOUT AN SPI TRANSMISSION MUST BE KNOWN AND ENTERED INTO THE DEVICE IN ORDER TO PROPERLY DECODE.

NOTE that any of these parameters can be adjusted AFTER a properly synchronized signal is displayed or paused, if necessary, while observing the waveform and decoded data. All settings except for the chart enable toggle are saved in a configuration file.

Adjust MODE: Clock polarity and phase are indicated with a pair of binary digits, the first digit indicates polarity, with "0" having a low base, with clock pulses going positive, while "1" indicates a high base or rest position with clock pulses going negative. The second binary digit adjusts whether data is read from the leading clock edge "0" or trailing clock edge "1". Select the 4 possible combinations with the left toggle.

Adjust DATA BIT DIRECTION: Press CENTER RIGHT TOGGLE to shift cursor to ">" just to the right of the mode indicator bits. Change with left toggle. ">" indicates a MSB or most significant bit first transmission while "<" indicates a LSB or least significant bit first type.

WORD LENGTH can be specified in one of 3 ways: 1) Manually 2) AUTO or 3) Reset after space, meaning a space of a certain length between clock word bursts. Change with LEFT TOGGLE: display will change from extreme left: 145 ... 3 > AUTO > 2 ... 192 with numbers to the left of AUTO denoting "RESET AFTER SPACE" or ") < xxx > (" mode and the number of samples to reset word length upon, and numbers to the right "MANUAL mode" or "BITS=XXX" and the number of bits to reset on.

The first type ("BITS=XXX) sets the word length manually and will not reset on spaces after the trigger point but simply continuously counts bits, resetting on the selected word size. Use for example with a continuous stream of clock pulses without spaces between words. Bit numbering will simply jump across spaces if the setting does not correspond to the number of clock pulses in a burst and continue increasing. Also use this mode with bits set at 7 or 8 bits to display ASCII characters in chart.

"AUTO" resets word size on any space between bursts that is greater than 2 clock pulses. Can be used for virtually all transmissions, specially useful when word size varies.

The last case ") < xxx > (" manually sets the length of a space, in samples, that the word length will reset upon. There are 30 samples to a screen division, 6 to a minor division. This needs to be set to a value greater than the distance between clock pulses, but less than the space between the word clock bursts. Useful when the word length changes during a transmission. It can also be used to manually synchronize the decoder to a continuous data stream that lacks the necessary space before the waveform trigger point to reset the word size, provided SOME space greater than a clock space (1/2 period) is available. Default space before triggering is 60 samples or 2 divisions, regardless of the X position. Anything prior or to the left of this is disregarded.

CALIBRATION PROCEDURE

Proper calibration minimizes DC offsets of the analog channel traces, provides proper DC tracking as Y position is moved up/down, amplitude calibration of the displayed waveforms and meter readings, compensation for the CPU clock frequency as it affects the frequency/time meters and minimizes offset variations and gain changes as the battery and/or power supply voltage changes.

If calibration menu (HOLD BUTTON 2) is done while the menu is NOT on either CHANNEL A OR CHANNEL B (OR ONE OF THEIR SUB MENUS) the ADC OFFSET adjustment will be accessed instead, with a value appearing in the NOTIFICATION AREA from 0 to 54. Default is 54. Adjust with LEFT TOGGLE then save in boot up config #0.

WHAT THIS CONTROL CHANGES:

While the ADC provides 256 "steps" (8 bits), only 200 are used for the display. The original programs used steps 0 to 200, discarding the top 56 at the top of the screen. Unfortunately, there is quite a bit of non-linearity (compression) in the bottom 50 or so steps, causing distortion of the waveform. This is a well know hardware issue for these devices. In order to compensate for this, the operating point was shifted up by 54 steps, moving the entire range into a more linear area towards the top of the screen. In addition to minimizing the distortion at the bottom, this also helped the calibration procedure achieve better results, as it assumes linear ADC operation. However there have been instances where, perhaps in some ranges and not in others, the preamp failed to fully swing the signal to the top of the ADC range, resulting in visible clipping below the top to the screen. This control can be used if desired to bring the operation point down below the point where clipping occurs by shifting it down from a value of 54, albeit at the expense of engaging down more into the non-linear area at the bottom of the range.

To ENTER CALIBRATION, the menu MUST BE EITHER ON CHANNEL A OR CHANNEL B (blinking). Does not matter which sub-menu, as long as it's of either chA or chB.

To enter the calibration process HOLD BUTTON 2 (about 3 seconds).

THE FOLLOWING SEQUENCE OF FUNCTIONS WILL BE DISPLAYED: (Instructions will be shown on screen)

>NOTE that any of these can be skipped, as some are tedious, but they are available for those who want the best results. At the MINIMUM AUTO CALIBRATION of DC offsets is easy and should be done. If 2 sets are saved as described below, effects from variations of battery voltage/ power supply will be compensated for.

1) MASTER CLOCK FREQUENCY OFFSET: at this point, the built-in generator will be set to a 1Mhz square wave. To calibrate, connect a frequency counter to the WAVE OUT and measure the frequency. Enter any discrepancy from 1.000000 Mhz by using left toggle: + values if counter frequency is high, - if it's low. For example, if the counter reads 1.000085 Mhz, enter +85. If it reads 0.999965 Mhz, enter -35. If no counter is available, just leave it at zero. Press button 2 to go to next screen.

2) AUTO CALIBRATION: You will be prompted to ground the relevant channel's probe and press button 2. This minimizes DC offsets of the 2 analog channels, as well as offset tracking as Y position is changed. For the next few screens, follow on screen instructions to go to the next function, other channel, to abort or load default settings.

3) VOLTAGE GAIN CALIBRATION: After auto calibration of offsets, selecting the next operation will bring up gain calibration. In this section, you will be prompted to connect a reference DC voltage to the channel you are currently calibrating, for each of the 8 ranges starting with the 50mv/div range. Applied voltage must be within the range displayed at the top of the screen, so a stable source adjustable over a wide range with low noise will be needed. An indicator is provided to show if the voltage is exactly on one of the ADC's "steps". This helps accuracy, however if there is much noise superimposed on the input (from nearby switched mode power supplies or from the DC source itself) or if the source is not finely adjustable, it may be hard to center the indicator, specially at the lower ranges; in such a case just disregard it. The reading (flashing) on the menu for the range selected is then adjusted with the LEFT TOGGLE to EXACTLY MATCH THE APPLIED VOLTAGE. Follow direction on screen to select the other ranges.

AT THE END you will be prompted to enter this either as a LOW BATTERY CALIBRATION with BUTTON 2 or HIGH BATTERY CALIBRATION with BUTTON 3: If calibration (auto calibration of DC offsets as well as voltage gain) is done with a relatively low battery (~1/4 to 1/2 charge) and saved with button 2, then done again with a charger connected and saved with button 3, two extra sets of data will be saved and the program will interpolate between the two as battery/power supply changes, minimizing the effects on offsets and gain. These devices are notorious for poor regulation affecting these. If a second calibration is NOT DONE, the program will simply just use the first one. IF IT IS DESIRED TO SKIP GAIN CALIBRATION: Just keep the input grounded and leave whatever residual readings are in the different range fields, move down through the fields with right toggle and go on to the next step. Follow on screen directions to either save and exit, or go on to calibrate the other channel.

CALIBRATION DATA is SAVED on the config file (XXXX.WPT), along with any other settings present at the time. NOTE that although calibration data is also saved to any of the additional config files (CONF00X.CFG) along with the settings when saving to these, it is NOT READ when LOADING these to restore the settings. Calibration is only read from the boot-up file (WPT) to prevent possible interference from older saved data after a subsequent calibration is performed.

HARDWARE AND COMPATIBILITY ISSUES

COMPATIBILITY

- This version should be compatible with:
- Hardware V2.6 and later (including the later 8Mb devices)
 - Sys V 1.51 and later
 - FPGA V2.61 and later
 - ALTERBIOS V 0.4 Should be installed on 2Mb devices to fix file corruption issues. Developed by Petteri Aimonen, available at <http://koti.kapsi.fi/jpa/dsoquad/> (along with a variety of other interesting software for the Quad)

HARDWARE ISSUES

For SPI decoding, the clock can be either on Ch B or Ch C. Prior to hardware V2.72, these devices had protection diodes that severely limited the bandwidth and timing of the digital channels. Unless these are removed, at the speeds SPI typically uses, using Ch C the waveform will be so far out of sync (if it triggers at all), that the function will be useless. For these devices, Ch B can be used for the clock but decoding will then be restricted to Ch A only.

The effect of the fix for the CH B FPGA ERROR on the newer hardware version 2.81 is unknown at this point. If this has now been fixed with the new FPGA IC and code, this will have the opposite effect of causing the same error present in earlier devices (a somewhat ragged display associated with the 2 least significant bits being swapped)

- The programs and system versions used with these devices make use of undocumented hardware resources. Specifically:
- Units come with an ADC rated for 40MS/sec which is overclocked to 72MS/sec
 - The wave out generator in the community versions (including this one) overclock the uP DAC, which is rated for 1Mhz, to 1.8Mhz at the highest analog range.
 - Some versions (including this one) make use of a larger amount of RAM than is documented for the uP version installed.
 - Some programs make use of undocumented areas of ROM to store themselves on.

While most devices seem take these in stride, some samples have been found that had issues with overclocking the ADC. One device produced nothing but garbage at the fastest time bases, while at lower speeds with lower sampling rates worked OK. This unit was found to have an ADC NOT from Analog Devices, like the originals, but a clone. The device also showed premature clipping of waveforms at the top of the screen, indicating an issue with the preamp/ADC analog "window" interface. After this was replaced with an Analog Devices chip everything worked fine.

Another device exhibited triggering issues at the fastest time bases, but only on one channel, not the other, and only on some triggering modes. This was observed with a variety of system and program versions.

It's important to note these are problems with the hardware and not with the system/program files installed.

CREDITS

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pmoss69
JackTheVendicator

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JPA for the Alterbios patch.
Jerson for suggesting a beep to indicate long button press. (V4 includes a visual indicator for this as well)

